U.S. Department
of Transportation

FEDERAL HIGHWAY ADMINISTRATION
Office of Environment and Planning
Environmental Analysis Division
Noise and Air Quality Branch
HEP-41

DATE October 10, 1995

NOTE TO: Director, Planning and
Program Development

FROM: Jim Shrouds
Chief, Environmental Analysis Division

Subject: Distribution of Particulate Matter Guidance Document

Since issuance of the final rule on transportation conformity in November 1993, reductions in PM-10 have become a significant issue for many areas including both rural and urban settings. The urban area problem is generally associated with emissions from diesel vehicle fleets such as buses while rural PM-10 problems are related to reentrained dust particles from pavement. We are working with several areas and with the Environmental Protection Agency to explore solutions that contribute to PM-10 reductions and enable transportation plans, programs, and projects to proceed. With this memo, we want to provide you with an interim report on the situation and potential solutions. Attached to this memo is a PM-10 guidance document that addresses the following issues:

1) Background data on PM-10;

2) Transportation options to reduce PM-10;

3) Modelling considerations on PM-10 emissions;

4) Current PM-10 related conformity issues;

5) PM-10 nonattainment area SIP requirements and status;

6) EPA actions affecting PM NAAQS; and

7) List of DOT contacts for more information on PM-10 issues

We are continuing to provide PM-10 technical assistance to several areas, both to assist them and to enable us to develop recommendations and strategies for general use. As we learn more about PM-10, we will provide more information to you. In the meantime, please contact Kevin Black of my staff at 202-366-9485 or one of the individuals listed on the Attachment for further information or to let us know of any useful insights or experience in your region.

Particulate Matter (PM-10) Guidance Document

Federal Highway Administration
Office of Environment and Planning
Environmental Analysis Division
October 1995

Table I. Past and current National Ambient Air Quality Standards (NAAQS) for particulate matter (PM).

Particulate Matter Standard		Primary	Secondary
Total Suspended Particulate (TSP), 30, 1971 to July 1, 1987 (36 FR 8186, 4/30/71)	April	260 $\mu g/m^3$ (24-hour avg.)	150 $\mu g/m^3$ (24-hour avg.)
		75 $\mu g/m^3$ (annual avg.)	60 $\mu g/m^3$ (annual avg.)
Particulate Matter Smaller than 10 Micrometers (PM-10), effective July 31, 1987 (52 FR 24634, 7/1/87; 40 CFR 50.6)		150 $\mu g/m^3$ (24-hour avg.)	150 $\mu g/m^3$ (24-hour avg.)
		50 $\mu g/m^3$ (annual avg.)	50 $\mu g/m^3$ (annual avg.)

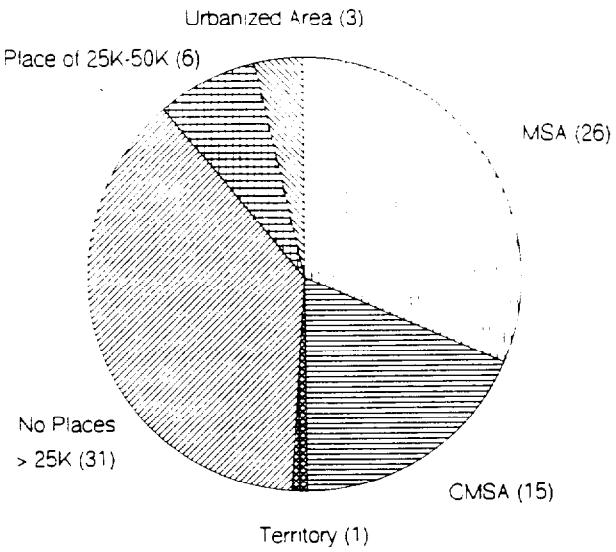

Figure 3. PM-10 nonattainment areas distributed by population designation for the county (or counties) where the nonattainment area is located. " No Places > 25K" denotes that the county which includes the nonattainment area does not have a Place (per Bureau of Census area classifications) larger than population 25,000.

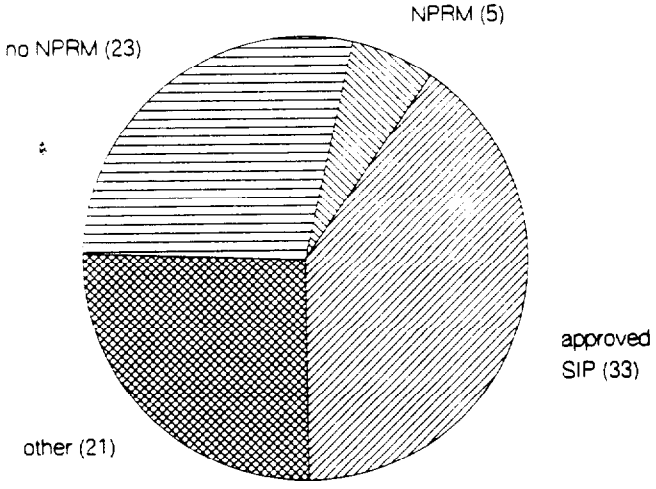

Figure 4. Control strategy SIP status of PM-10 nonattainment areas as of 2/24/95. "Other" denotes areas which are: designated serious; located on an Indian reservation; or have a SIP submittal date after 1/95. Six of the "approved SIP" areas were not granted full approval.

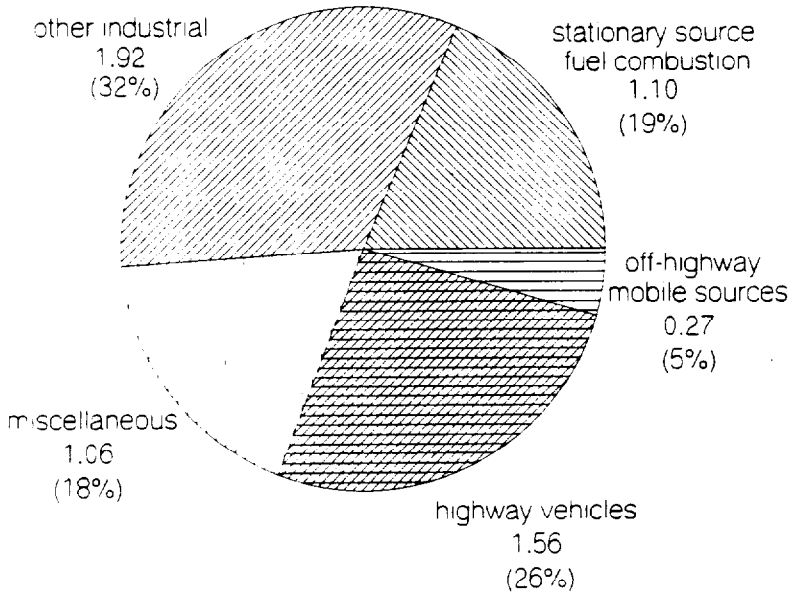

Figure 5. Nationwide 1992 PM-10 emissions. Does not include fugitive emissions. Total emissions are 5.93 million short tons/year. Data from National Air Quality and Emissions Trends Report 1992, EPA 454/R-93-031, October 1993.

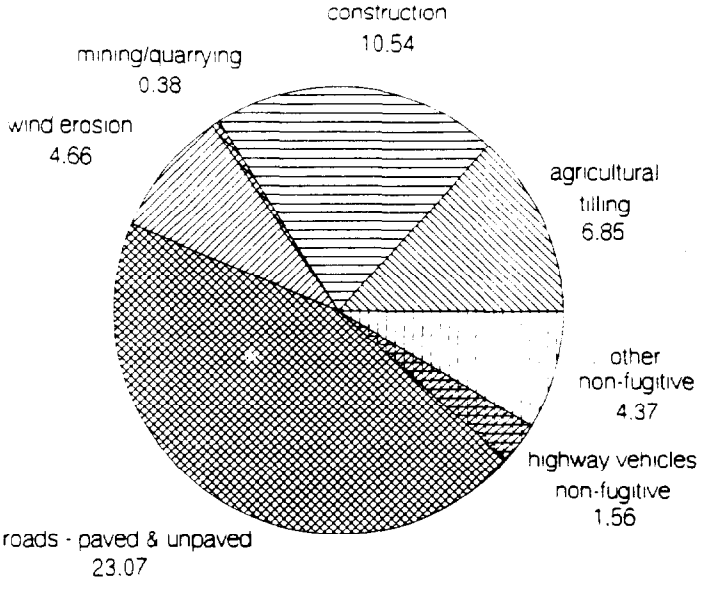

Figure 6. Nationwide 1992 PM-10 emissions including fugitive dust sources. Total emissions are 51.43 million short tons/year. Data from National Air Quality and Emissions Trends Report 1992, EPA 454/R-93-031, October 1993.

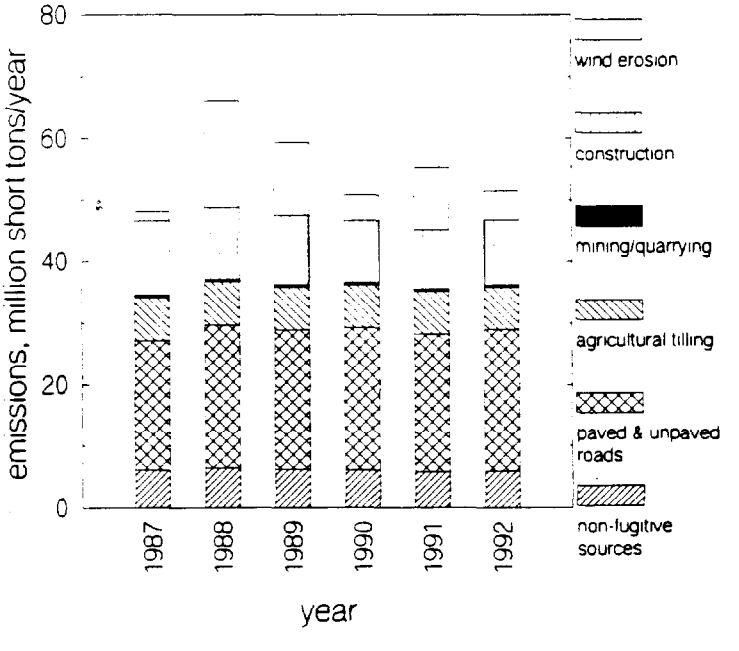

Figure 7. Nationwide PM-10 emissions from fugitive and non-fugitive sources. Data from National Air Quality and Emissions Trends Report 1992, EPA 454/R-93-031, October 1993.

Table II. Motor vehicle contributions to selected base year emission inventories.[1]

Nonattainment Area	Non-fugitive emissions,%	Fugitive (road dust) emissions[2],%
Aspen, CO	0.2	98 (p)
Pagosa Springs, CO	<0.1	98 (p-78,u-20)
Presque Isle, ME	- -	88 (p,non-fugitive)
Canon City, CO	1.3	87 (p-44,u-43)
Mendenhall Valley, AK	-	86 (p-46,u-40)
Telluride, CO	1	82
Phoenix, AZ	- -	>80 (p,non-fugitive)
Sheridan, WY	0.5	74
El Paso, TX	-	65 (U.S. only)
Eagle River, AK	0.1	57 (p-37,u-20)
Butte, MT	0.2	54 (p)
Missoula, MT	-	47-82 (seasonal)
Seattle, WA	9	48
Denver, CO[3]	4	39 (p-34,u-5)
Columbia Falls, MT	-	38
LaGrande, OR	up to 5	31-36
Lamar, CO	<3	24
Salt Lake County, UT[3]	8	8
Utah County, UT[3]	1.4	2
Kent, WA	"insignificant"	second in significance after a single point source
Olympia/Tumwater/Lacey, WA	"insignificant"	second in significance after residential wood combustion
Rochester, MN	"insignificant"	"small/insignificant"
St. Paul, MN	"insignificant"	"small/insignificant"
Cuyahoga County, OH	"insignificant"	"small/insignificant"
Stuebenville-Follansbee, OH-WV	"insignificant"	"small/insignificant"
Oglesby, IL	0	0
Vermillion County, IN	0	0
Anthony, NM	0	0

1) Depending on the area, base year inventories may be annual, seasonal, or 24-hour worst case scenario.
2) p = paved roads, u = unpaved roads
3) Emission inventory is a reconciliation of PM-10 direct emission inventory and receptor modeling estimation of secondary particulate burden. Motor-vehicle derived secondary emissions (nitrogen oxides and/or sulfur dioxide) were deemed significant in each of these areas.

- o Private sector financing - construction projects which generate fugitive dust must obtain offsets from the paving of unpaved roads; companies in compliance with regulations subsidize emission-reducing measures such as the purchase of chemical de-icers.
- o Tradeable permits - cap permissible emission levels via tradeable permit programs which allow trades between source categories (e.g., stationary versus mobile sources).

Best Available Control Measures (BACM) for fugitive dust control are summarized in another EPA document.[3] A variety of prevention and mitigation measures are discussed; control efficiencies for selected measures are also cited. Available control measures for transportation-related fugitive dust BACM include -

- paved roads
  - o improvements in sanding/salting applications and materials - control of material specifications such as silt content and degradability, control of materials application rate.
  - o truck covering - reduces amount of material blown from hauling trucks onto the roadway.
  - o prevention of track-on/wash-on - construction site measures, curb installation, shoulder stabilization, and storm water drainage.
- unpaved roads
  - o paving - paved road dust emission factors are substantially lower than unpaved road dust emission factors.
  - o chemical stabilization - suppresses the entrainment of fugitive dust.
  - o surface improvement (graveling) - reduces the amount of available dust for suspension.
  - o vehicle speed reduction - unpaved road dust emissions decrease with decreasing vehicle speed.

Table III summarizes the transportation-related control strategies for selected PM-10 nonattainment areas as summarized in control strategy SIP NPRMs and corresponding Technical Support Documents (TSD). The type of control strategy - if any - depends on local conditions which vary widely between nonattainment areas. For areas where unpaved road emissions are significant, road paving is a popular strategy. For the case of paved road dust emissions, street sweeping and reduced track-out measures

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[3] Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, EPA 450/2-92-014, U.S. Environmental Protection Agency, September 1992.

Table III. Motor Vehicle/Roadway Control Strategies in Selected PM-10 Nonattainment Areas.

Nonattainment Area	re-entrained road dust from unpaved roads[1]			re-entrained road dust from paved roads				tailpipe standards
	priming	strip paving	recycled asphalt paving	street sweeping/ flushing	sanding control measures[2]	reduced track out	VMT reduction measures	
Eagle River, AK		✓	✓		✓	✓		
Mendenhall Valley, AK		✓						
Aspen, CO		C		✓	✓;C		✓[3]	
Canon City, CO				✓;C	✓			
Denver Metro, CO				✓	✓		✓[4]	✓[4]
Pagosa Springs, CO		✓		C	✓			
Butte, MT				✓	✓			
Columbia Falls, MT		✓		✓	✓	✓		✓
Missoula, MT				✓	✓;C			✓
Anthony, NM	✓	✓		✓				
Springfield/Eugene, OR						C		
El Paso, TX		✓[5]		✓				
Salt Lake County, UT					✓			✓[6]
Utah County, UT					✓			✓[6]
Sheridan, WY				✓	✓;C			

✓ = MEASURES IN THE CONTROL STRATEGY SIP; C= MEASURES IN THE CONTINGENCY PLAN SIP

1) Projects assumed to be strip paving unless specifically stated to be recycled asphalt paving.

2) Includes reductions in sanding material usage and tighter material specifications.

3) Aspen, CO - includes mass transit service expansion (no credit taken), crosstown shuttle service, commercial core paid parking (no credit taken), intercept lot and shuttle (no credit taken), peak hour bus priority lane, and event strategies (no credit taken).

4) Denver, CO - includes urban bus particulate standards, light-duty vehicle and truck NOx standards, diesel fuel sulfur limitations, MAC light rail line, express bus service from Denver to the new Denver International Airport, CommuterCheck program, ECOPass, and CU student bus pass.

5) El Paso, TX - includes unpaved road dust control via watering and/or chemical stabilization.

6) Utah County and Salt Lake County, UT - includes a statewide diesel I/M program.

total PM-10

- exhaust PM-10
- brake wear emissions
- tire wear emissions
- indirect sulfate (ammonium sulfate particles formed by atmospheric reaction of gaseous sulfur dioxide exhaust)

PART5 calculates the secondary (indirect) sulfate particulate matter formed by emissions of gaseous sulfur dioxide (SO_2) but does not calculate the secondary organic or nitrate particulate matter formed from gaseous hydrocarbon (HC) and nitrogen oxides (NO_x) emissions, respectively. All three precursors (SO_2, HC, and NO_x) are considered when constructing particulate matter emission inventories. However, EPA conformity regulations require a consideration of HC and NO_x -- but not SO_2 -- as PM-10 precursors.

Emission factors for light-duty gasoline vehicles (LDGV) and heavy heavy-duty diesel vehicles (HHDDV) are shown in Figures 8 and 9, respectively. Note the ordinate scale for the HHDDV graph is 50 times greater than the scale for the LDGV graph. Over the thirteen year period of 1988-2000, the total PM-10 emission factor decreases by 18% for the LDGV fleet and 64% for the HHDDV fleet. Exhaust emissions are less than one-third of the LDGV total PM-10 emissions; in contrast, exhaust emissions are a majority of the HHDDV total PM-10 emissions. Low-sulfur diesel fuel requirements are responsible for the sharp decrease in non-exhaust HHDDV emissions between 1992 and 1993.

Figure 10 shows the fleet-average emission factor trends using the PART5 model default VMT distributions. Exhaust emissions represent slightly more than one-half of the total PM-10 emissions. The total PM-10 emission factor decreases 45% over the period 1988-2000. Vehicle class contributions to the total VMT and fleet-average emission factor are shown in Figures 11 and 12, respectively, for the years 1988 and 2000 (i.e. the first year and last year of Figure 10). For the purposes of this report, vehicle classes have been lumped as follows -

- LDGV
- OtherGV (LDGT1,LDGT2,HDGV,MC)
- HDDV (2BHDDV,LHDDV,MHDDV,HHDDV,BUSES)
- OtherDV (LDDV,LDDT)

For the 1988 default VMT mix, heavy-duty diesel vehicles (including buses) account for 60% of the total motor vehicle PM-10 emissions. By 1990, the heavy-duty diesel vehicle contribution has decreased to 47%. Figure 13 shows the distribution of particulate sources contributing to the total PM-10 emission factors. "Other" emissions are exhaust emissions after subtracting out the tailpipe sulfuric acid (direct sulfate)

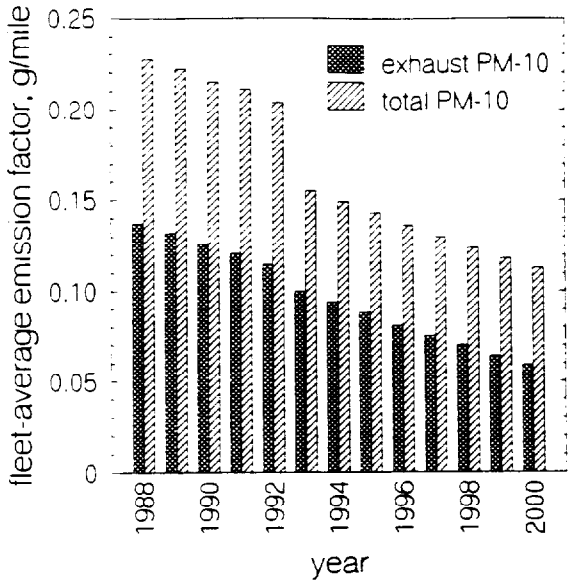

Figure 10. Fleet-average emission factor estimates using default vehicle age and VMT distributions. Fugitive dust emissions are not included.

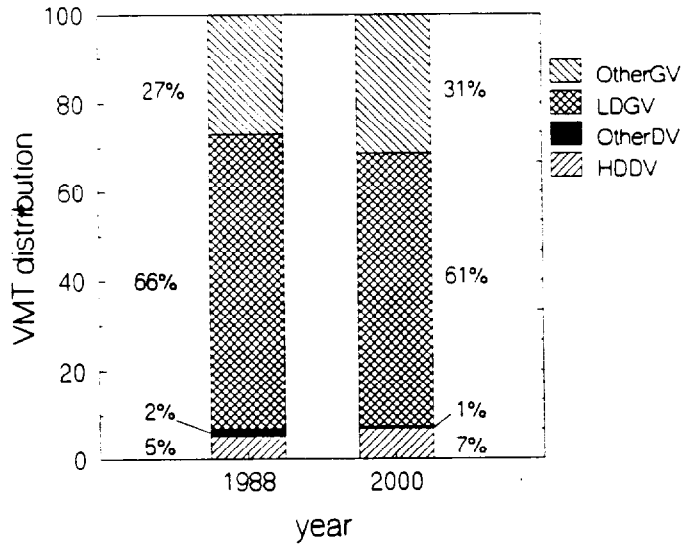

Figure 11. Default VMT distribution for the calendar years 1988 and 2000.

contribution. The relative contribution from non-sulfate exhaust emissions drops by about 10%; this is reflected by a 10% increase in the relative contribution from brake and tire wear emissions.

From this analysis using default vehicle age and VMT distributions, fleet-average PM-10 emission factors decrease by about 45% over the period 1988-2000. While the relative contribution from heavy-duty diesel vehicles is decreasing, it will still account for 50% of the year 2000 emissions.

Fugitive Motor Vehicle Emissions

Now consider the role of fugitive emissions generated by resuspended road dust. The emission factors are very sensitive to independent variables such as silt loading and precipitation frequency. For the purposes of this report we shall assume a collector or highway with "average" silt loading (0.5 g/m_2) and moderately frequent precipitation events (140 days per year with precipitation exceeding 0.01"). Paved road fugitive dust emission factors were generated from PART5 subject to the corrections described in the information sheets released by EPA Default values were used for other parameters including the VMT mix.

In contrast to the trends for non-fugitive motor vehicle particulate, the emission factors for fugitive emissions (in the absence of mitigation measures) increase over the period 1988-2000 for the conditions of this study. Figure 14 shows the fleet-average emission factor for paved roads using the previously stated assumptions. An 18% increase in the emission factor is predicted over the period 1988-2000; this arises from the shift in default VMT distribution over time to heavier vehicle classes. There are no vehicle-based technological improvements to reduce resuspended road dust emissions. In addition, absolute emissions (fleet-average emission factor times VMT) will exhibit a still greater increase in areas predicting VMT growth.

Figure 15 shows the relative contributions from fugitive and non-fugitive sources to the 1988 and 2000 fleet-average motor vehicle emission factor for the paved road conditions specified above. Resuspended road dust accounts for 93% and 97% of the total motor vehicle-related emissions for the years 1988 and 2000, respectively. In many cases - such as unpaved roads or arid regions - the fugitive dust contribution will be even greater. Emission factors estimated using the PART5 model are consistent with nationwide annual emission estimates. In both cases, emissions from motor vehicle-induced fugitive dust are much greater than motor vehicle non-fugitive emissions.

The paved road dust emission factor is a function of silt loading. Given the wide variation in silt loading across various geographic locations, the use of locally-defined silt loading factors are encouraged. EPA granted Denver permission to use emission factors which were correlated directly with roadway classification rather than silt loading. The Denver area is now looking into a new approach which correlates paved road emission factors with VMT rather than silt loading or roadway classification. Using conventional approaches, the same VMT on different roadway classifications yields different emission factors. Using the proposed new approach: the same VMT on different roadway classifications would yield the same emission factor; and emission factors would vary with VMT within a given roadway classification.

nonattainment problem should pursue the applicability of conformity requirements with the EPA and the State air agency through the consultation process. Future control strategy SIP submissions must explicitly state the role of transportation-related PM-10 (and PM-10 precursor) emissions.

Conformity Periods

There are three conformity periods - interim Phase II period (hereafter called the interim period), transitional period, and control strategy/maintenance period (hereafter called the control strategy period). The interim Phase II period began on December 27, 1993, and applies until the State submits to EPA a control strategy SIP which has been endorsed by the Governor and subjected to a public hearing. Submittal of the control strategy period marks the end of the interim period and start of the transition period. The transition period subsequently applies until the EPA has made a final decision (either full approval or full disapproval) on the control strategy SIP. If disapproved, the interim criteria apply; if approved, then the control strategy period commences. The control strategy period applies until twenty years after the area has been redesignated to attainment status.

Frequency of Conformity Determinations

Two sets of criteria establish the minimum frequency of conformity determinations in PM-10 nonattainment areas which are geographically covered (at least in part) by metropolitan transportation plans and transportation improvement programs (TIPs). According to the generic criteria, conformity must be redetermined by May 25, 1995, or existing plans/TIPs will lapse. Thereafter, new conformity determinations are required no less frequently than every three years. EPA approval of any SIP (other than the initial control strategy SIP) which establishes or revises the motor vehicle emissions budget(s) triggers the requirement for a new conformity determination within eighteen months. Examples include a maintenance plan SIP or revisions to the control strategy SIP. In each case, conformity must be determined using the appropriate criteria (interim Phase II, transition, or control strategy).

In addition to the above generic criteria, the deadline for submission of the initial control strategy SIP triggers the requirement for a conformity determination within one year after the submission deadline (unless the deadline was prior to November 24,1993; in this case, conformity must have been determined by November 25, 1994). Thus, for PM-10 nonattainment areas with control strategy SIPs due on November 15, 1991, conformity must have been redetermined (using the transition

strategy SIP emissions inventory baseline and thus these years could also be used as the baseline for the purposes of conformity.

Analysis years for which the test shall be applied are defined as follows: (a) the analysis years must be no more than ten years apart; (b) the first analysis year shall be no later than four years and six months after the nonattainment designation; (c) the second analysis year shall be the attainment year unless the attainment year is earlier than the first analysis year (in this case, the second analysis shall be at least five years beyond the first analysis year); and (d) the final year of the plan forecast period must be an analysis year. Thus, for PM-10 areas designated nonattainment by operation of law effective November 15, 1990, the first analysis year must be no later than 1995 and the second analysis year must be no later than 2000.

Transition Period

Conformity determination requirements during the transition period are as follows. The regional emissions analysis must pass the test required under the interim Phase II period (i.e. pass the build/nobuild test or the emission less than baseline levels test). In addition, the budget test must be passed. Horizon years must include the attainment year and the final year of the transportation plan forecast period. Milestone year emissions may be determined by interpolation. The emissions analysis must be performed for each milestone year, the attainment year, and each analysis or horizon year after the attainment date.

The regional emissions analysis to be compared to the SIP budget must be consistent with the SIP budget. The same assumptions regarding season and conditions should be made as were used in preparing the emissions budget for the SIP. If different assumptions/conditions are used, they must be justified and appropriate correction factors must be implemented.

Control Strategy Period/Maintenance Period

In this case, only the budget test - as described under the transition period requirements - must be passed.

<u>Emissions Modeling and Assumptions</u>

Transportation-related emissions estimation procedures for the purposes of conformity must be based on the latest emissions model. EPA has indicated that the PART5 model will be the "latest emissions model" for regulatory purposes such as PM-10 nonattainment area SIP development. Thus, this model will be required for regional analysis conformity determinations subject to a grace period and phase-in policies. The grace period/phase-

submitted prior to November 24, 1993. If these SIPs quantified a safety margin of emissions, these excess emissions can be used for the conformity analysis upon satisfying the requirements outlined above.

Maintenance plan SIPs are currently required to contain an emissions budget only for the final year of the ten-year plan. EPA will issue guidance regarding the definition and use of emissions budgets for the purposes of conformity during the maintenance period.

Budgets for Serious PM-10 Nonattainment Areas

Serious PM-10 nonattainment areas are bound by the interim conformity criteria until they submit a SIP which demonstrates attainment. An area may submit a SIP which does not demonstrate attainment (and indeed, are required to submit a moderate nonattainment area control strategy SIP even when reclassified to serious nonattainment). Such SIPs do not have budgets and are not considered control strategy SIPs for the purposes of transportation conformity.

Table IV. Timetable for PM-10 nonattainment area major provisions.

Action/Requirement	Areas Designated Nonattainment on 11/15/90	Areas Designated Nonattainment After 11/15/90	Comments
Moderate Areas			
Control Strategy SIP	November 15, 1991	18 months after designation	
Contingency Measures SIP	November 15, 1993	three years after designation	
Attainment Date	December 31, 1994	December 31, six years after designation	two extensions may be granted, each for one year
Serious Areas			
Best Available Control Measures (BACM) SIP	implementation SIP to be submitted 18 months after reclassification to serious with BACM implementation within four years after reclassification		
Attainment Demonstration SIP	(a) four years after reclassification to serious if reclassified based on a determination by EPA that the area cannot practicably attain the NAAQS by the statutory deadline for moderate areas; (b) 18 months after reclassification to serious if reclassified for actually having failed to achieve the NAAQS by the moderate area attainment date		moderate area Control Strategy SIP must still be submitted
Contingency Measures SIP	three years after reclassified to serious		
Attainment Date	December 31, 2001	December 31, ten years after nonattainment designation	one extension may be granted for a period of up to five years
All Areas			
Quantitative Milestones	every three years until attainment	every three years until attainment	time clock starts from Control Strategy SIP deadline date; must demonstrate reasonable further progress

Nonattainment Area Classification and Status

Sixty-nine areas were designated moderate PM-10 nonattainment by operation of law effective November 15, 1990; five of these areas have subsequently been reclassified as serious nonattainment. An additional thirteen areas were designated moderate PM-10 nonattainment after November 15, 1990. Thus, as of February 24, 1995, there were eighty-two PM-10 nonattainment areas; these areas are listed in Tables VI and VII. EPA has announced its intent to also designate the following areas as moderate PM-10 nonattainment: portions of Weber County, UT; and Kootenai County, ID (excluding the Coeur d'Alene Indian Reservation).

Table VII. PM-10 nonattainment areas as of 2/24/95 (additional areas listed in Table VI).

Moderate Areas, attainment date December 31, 1999 (3 Areas)

Region 8
Whitefish, MT

Region 9
Mono Lake, CA

Region 10
Lakeview, OR

Moderate Areas, attainment date December 31, 2000 (10 Areas)

Region 2
New York County (Manhattan), NY

Region 3
Weirton, WV

Region 8
Steamboat Springs, CO
Thompson Falls, MT

Region 9
Bullhead City, AZ
Payson, AZ
Sacramento County, CA
San Bernardino County, CA

Region 10
Shoshone County, ID
Oakridge, OR

Serious Areas, attainment date December 31, 2001 (5 Areas)

Region 9
Coachella Valley, CA
Owens Valley, CA
San Joaquin Valley, CA
South Coast Basin, CA
Las Vegas, NV

timetables were defined including: draft criteria document finished by April 1995; and Clean Air Scientific Advisory Committee (CASAC) review of the criteria document completed by August 1995.

EPA is not resistant to conducting another PM review. Rather, they were opposed to the tight timetable requested by ALA. In April 1994, EPA published a Federal Register notice announcing an effort to update and revise the PM-10 Air Quality Criteria Document. This represented a preliminary step in initiating a full review of the PM matter NAAQS standard. EPA subsequently sponsored a series of workshops to facilitate the preparation of the criteria document, and issued a draft version for public review through a Federal Register notice in April 1995.

At this time, one can merely speculate about potential revisions to the PM standard. One action would keep the current size range (PM-10) and define either higher or lower threshold concentrations. Another action would define a new standard for smaller particles (e.g., PM-2.5) and set appropriate threshold concentrations. A third action would include a composition-based factor such as the "acid" content. These actions could be adopted separately or in concert as revisions to the existing PM standard. For example, the introduction of a PM-2.5 standard could coincide with the elimination of the PM-10 standard (effects deemed not important), a revision to a higher PM-10 threshold concentration (effects deemed important but not at the concentration currently regulated), or a revision to a lower PM-10 threshold concentration (effects deemed important at a concentration lower than currently regulated). Yet another parameter to be determined would be the appropriate averaging time for each standard. The current PM-10 standards are based on 24-hour and annual averaging times; several additional averaging times (e.g., seasonal) are possible.